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Scheme for Non-Performing Mortgage Loans**

Lessons from Hungary's Case

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Institute of Economics, Centre for Economic and Regional Studies,
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for Non-Performing Mortgage Loans
Lessons from Hungary's Case

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Introduction of an Income Contingent Repayment Scheme for Non-Performing Mortgage Loans Lessons from Hungary's Case

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Abstract

In Hungary, more than 22% of the FX mortgage portfolio is non-performing and the tendency is worsening. In this paper we propose a solution to effectively reduce the credit and systemic risk inherent to this portfolio, but the proposed model can be applied to other mortgage portfolios in trouble, as well. The main element of our proposal is the income contingent repayment complemented with effective incentives to motivate debtors to repay their debt in a highly flexible way. We show that the proposed scheme is attractive both for the debtors and the lenders; therefore, contrary to some recent policy measures, in this case there is no need for direct state intervention to force modifications to the existing legal contracts. In order to evaluate the possible effects, we simulated a realistic population of borrowers with different age, debt, LTV and income. Then we calculated the expected income paths and the repayments of the borrowers, and also the profit of the lenders on the basis of the non-performing FX mortgage portfolio. The results underpin that the proposed scheme creates significant value added, and most importantly it can effectively reduce the vulnerability of the whole economy to future shocks.

Keywords: FX mortgage loans, emerging markets, management of credit and systemic risk, PTI, income contingent repayment, micro-simulation

JEL classification: E42, G17, G21, G28

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A jövedelemfüggő törlesztés bevezetése a nemfizető jelzáloghitelekre – a magyar eset tanulságai

Berlinger Edina - Walter György

Összefoglaló

Magyarországon a devizában denominált jelzáloghitel-portfólió nemfizetési aránya 22%-os, ami folyamatosan romló tendenciát mutat. Ebben a tanulmányban egy megoldási lehetőséget mutatunk be, amelynek segítségével hatásosan csökkenteni lehetne az ebből adódó hitelezési és rendszerkockázatot, de a megoldás kiterjeszthető bármilyen egyéb nemfizető jelzáloghitelekre is. Javaslatunk fő eleme a jövedelemfüggő törlesztés bevezetése, kiegészítve néhány fontos ösztönzővel, melyeknek segítségével a hitelfelvevők rendkívül rugalmasan, de vissza tudnák fizetni tartozásukat. Megmutatjuk azt is, hogy a konstrukció előnyös mind a hitelfelvevő, mind a bank számára, ezért – ellentétben néhány kormányzati intézkedéssel – ez a megoldás nem igényelné a szerződések állam által kikényszerített utólagos módosítását. Mikroszimulációs modellt építettünk annak érdekében, hogy felmérjük a javaslat hatását. Ebben az adósok életkora, eladósodottsága, jövedelme és hitel-/fedezetmutatója eltérő. Ezután kiszámítottuk a várható jövedelmi és törlesztési pályákat, illetve a hitelező nyereségét kifejezetten a nemfizető devizahitel-portfólióra nézve. Az eredmények alátámasztják, hogy a javasolt modell jelentős értéket teremtené és emellett csökkentené a gazdaság egészének sérülékenységét is.

Tárgyszavak: devizahitelek, jelzálog, feltörekvő piacok, hitel és nemfizetési kockázat kezelése, törlesztés-/jövedelemarány, jövedelemfüggő törlesztés, mikroszimuláció

JEL kód: E42, G17, G21, G28

1. INTRODUCTION

Credit dollarization is a phenomenon when market participants borrow in foreign currency, get access to the broader capital market and take significant exchange rate risk at the same time. Eichengreen and Hausmann (1999) called it as “original sin”, and they also warned that “dollarization eliminates all scopes for an independent national monetary policy”¹. Interestingly, they also admitted that dollarization may have positive effects as well, because by providing extra financing in illiquid periods it can attenuate business cycles and can even contribute to the stability of financial systems on emerging markets. However, the authors argue that dollarization can be beneficial only if capital standards, prudential supervision and regulation are strengthened. However, it seems that these prerequisites typically do not hold for the most dollarized countries. Yeyati (2006) carried out a worldwide empirical analysis and demonstrated that financially dollarized economies suffer from lower and more volatile growth and a greater propensity to banking crises. On this ground, he advocates for an active de-dollarization policy.

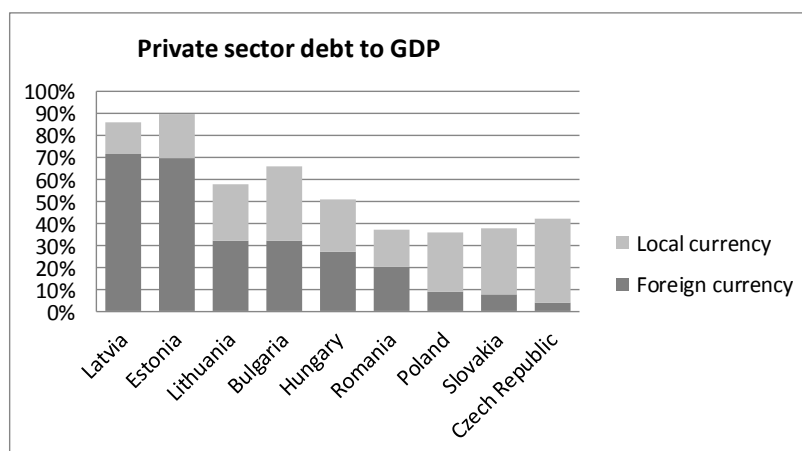
Originally, the term of dollarization refers to Latin American countries where almost all loans were denominated in U.S. dollars. However, in the first decade of this century Eastern European households and non-financial firms has also been massively borrowing in foreign currency, mainly in euro and Swiss franc. Several authors analyzed the driving factors and also the consequences of this process (e.g. Rosenberg, Tirpák 2008; Csajbók et al. 2010, Beer et al. (2010), Hudecz (2013)). European emerging countries show heterogeneity in terms of their credit-to-GDP ratios in foreign currencies. Latvia and Estonia have relatively high ratio; in other countries, like Lithuania, Bulgaria, Hungary and Romania, foreign currency credits are significant but less dominant; while borrowers in Poland, Slovakia and Czech Republic preferred to borrow in domestic currency, see Figure 1.

Due to the global financial crisis, employment, wages, real estate prices, foreign exchange and interest rates changed adversely; hence the ratio of non-performing loans increased sharply, which contributed to the further deepening of the crisis. In the most concerned countries where currency loans were the most escalated and other macro conditions were also unfavorable monetary policy became extremely difficult as any further devaluation of the home currency may generate an economic and social catastrophe. The systemic risk due to FX loans has become one of the most severe problems in these countries, as it is the case in Hungary too. In this paper we focus solely on Hungary but concepts and also the proposed strategy can be applied to the other countries in similar situation.

¹ See pp. 33

Figure 1

Private sector credit-to-GDP ratios in some EU New Member States, in 2007



Source: webpages of Central Banks

1.1. FOREIGN CURRENCY MORTGAGES IN HUNGARY

At the end of 2013 the total outstanding debt to the household sector amounted to USD 31 billion, out of which the mortgage portfolio was around USD 25 billion. The major part of mortgages, about USD 15.4 billion, was denominated in foreign currency (CHF, EUR or to some extent JPY), which accounted for approximately 13% of the GDP. More than 22% of currency based mortgage loans, USD 3.4 billion (2,8% of the GDP), can be regarded as non-performing (more than 30 days of delay).

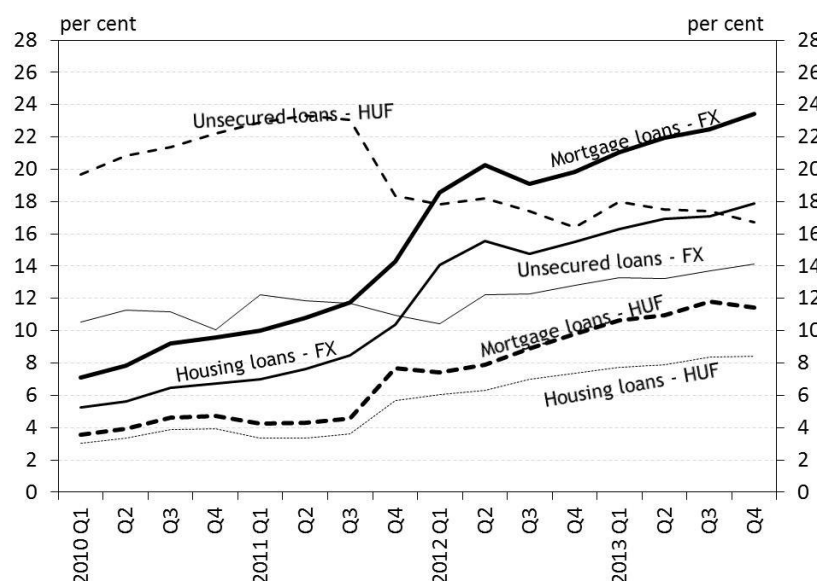
The size of the average FX mortgage loan is around USD 28 000 and its average maturity is 14-15 years. In line with the heavy appreciation of the Swiss franc and the increase in interest margins, households faced growing debts in HUF which together with the drop in incomes and employment boosted the payment-to-income (PTI) ratios together with the non-performing-loan (NPL) ratios, see Figure 2.

We can observe on Figure 2 that in the recent years almost all loan portfolios have been continuously worsening, but the worst tendency and the highest NPL ratio belong to the FX mortgage portfolio.²

² See MNB, National Bank of Hungary, Report on Financial Stability 2013 and Financial Stability Report 2014.

Figure 2

Ratio of non-performing household loans by products in the banking system



Source: MNB, National Bank of Hungary, Financial Stability Report 2014, chart 58

1.2. MEASURES TO SOLVE THE FX MORTGAGE PROBLEM

Banks and debtors have been making lots of efforts to manage FX mortgages by voluntary renegotiations and restructuration of the loan agreements, but these private initiations did not prove effective. Government and other supervisory institutions (Central Bank, Financial Services Authority, Banking Association) have also intervened in several forms to resolve the escalating conflicts. Some of the supervisory measures aimed at restricting and discouraging FX lending (temporary restriction of all FX lending, upper limit on the loan-to-value ratios for retail mortgage loans, ban on purely collateral based lending, redefinition of applicable conversion rates and other consumer protection type of provisions). Other provisions targeted a more prudential operation of the banks (capital adequacy and liquidity requirements). However, most of the legislative efforts have been initiated in order to assist FX debtors with the catchword of “protecting homes”³. In 2011In the framework of an *early repayment* program debtors could repay their loans at a fixed and highly preferential FX rate.

- Since 2012 a freshly implemented new *government agency* (NAMA, National Asset Management Agency) has purchased mortgaged residential properties of the most

³ https://felugyelet.mnb.hu/data/cms2408096/ESRB_guidelines_compliance.pdf

deprived debtors from the banks at a discounted price. Debts were cancelled and people could stay in their apartment while paying a favorable rental fee.

- A government-backed *exchange rate fixing scheme* was set up (in 2011-2012) and borrowers could join it voluntarily in order to defer the repayment burden of the remaining FX loans. The difference between the fixed, preferential FX rate and the actual market rate is collected on a special account as a HUF loan. The capital part of this deferred HUF loan is required to be paid back by the debtor after a grace period of 60 months, while the interest part is financed 50-50% by the lender bank and the central budget.
- Recently, (in 2015 autumn) a new *FX loan relief package* was accepted by the parliament which relies on the latest Hungarian supreme court's ruling. According to this, bid-ask margins applied by the banks during currency conversions were unfair and now have to be recalculated on the basis of the National Bank mid-prices and the difference should be reimbursed to the borrowers. Similarly, unilateral and unjustifiable increases in the interest rates are also to be refunded.
- The latest development is that in 2015-16 simultaneously with the settlement of loan charges deemed unfair, FX mortgage loans will have to be converted to HUF in a lump sum at the market rate (so called *mandatory HUF conversion*).

Table 1 summarizes the most important programs and their estimated costs to the banks and the state. In order to compare different country's policy mix to this problem, see Bethlendi (2001).

As we can see in Table 1, both banks and the government contributed to help the FX debtors, but the costs of these programs were mostly financed by the banking sector. It is especially true if we also take the bank levy into consideration, which is among the highest ones in Europe.⁴ It is also remarkable, that until now far the most expensive program was the *early repayment scheme* of 2011 which cost much more than all together the operation of the National Asset Management Agency, the Exchange Rate Fixing Scheme and the New Home Creation Program. Moreover, banks were obliged to accept early repayments at a highly preferential FX rate, hence the state intervened into contracts between private parties, which compromises the rule of law and the legal certainty. Moreover, it is also clear that the beneficiaries of this program were the most better-offs who could afford to repay their debt in a lump sum. It is also worth noticing, that the freshly announced new relief package is expected to cost three times more to the banks than the extensively criticized early repayment program. The forthcoming HUF conversion is to be managed by the National Bank of Hungary which provides the necessary FX liquidity using its reserves. Thus, this measure has

⁴ Bank levy was introduced in 2010. It is based on the size of the balance sheet and not on the profit. Since 2010 several banks in Hungary are in massive loss.

practically no direct costs, but being mandatory it is again a posterior change of private contracts forced by the state.

Table 1

Most important programs targeting FX mortgages

Program	Timing	Affected exposure* (bn USD)	Costs to the banks (bn USD)	Costs to the state (bn USD)	Total costs (bn USD)
Early Repayment Program¹	from Sept 2011 to Dec 2011	4.5	1.1 (value difference)	0.5 (tax reduction)	1.6
National Asset Management Agency²	from Jan 2012	0.15	0.08 (value difference)	0.07 (invested capital) 0,006 (operational costs per year)	0.16
Exchange Rate Fixing Scheme³	from May 2012	6.5	0.09 (interest rate subsidy)	0.09 (interest rate subsidy)	0.18
New Home Creation Program⁴	from 2012	-	-	0.55 per year (interest rate subsidy)	0.55 per year
New FX Relief Package⁵	2015	15.4	0.9 (margin) 3 (interest rate)	-	3.9
Mandatory HUF Conversion	2015-16	15.4	-	-	-

* The size of the total foreign currency mortgage portfolio was around 15.4 bn USD at the end of 2013. USD/HUF=230

¹ PSZÁF: Gyorselemzés a végtörlesztésről. 2012. március 12., 2. o.

² http://www.netzrt.hu/wp-content/uploads/2014/02/20140103_K%C3%B6zlem%C3%A9ny_T%C3%B6bb-ezer-elad%C3%B3sodott-csal%C3%A1don-seg%C3%ADtett-a-NET-program.pdf
http://www.netzrt.hu/wp-content/uploads/2014/06/NET-Zrt_2013_m%C3%A9rleg_eredm%C3%A9ny.pdf

³ http://felugyelet.mnb.hu/bal_menu/jelentesek_statistikak/statistikak/arfolyamgat

⁴ <http://www.parlament.hu/irom39/12002/adatok/fejezetek/42.pdf>

⁵ http://www.portfolio.hu/vallalatok/penzugy/mnb_ennyit_bukhatnak_a_bankok_csa_k_az_arfolyamres_miatt.202134.html

Source: compiled by the authors

One of the most important conclusions we can draw by assessing all these measures is that regardless of the enormous burden levied on the banking sector and the drastic state interventions into legal contracts (early repayment at preferential rate and mandatory HUF

conversion) the total household leverage remains significant, therefore low-income people may have difficulties to repay their debts even in HUF, hence systemic risk remains an important issue.

2. THE PROPOSED STRATEGY⁵

When formulating our proposal to manage non-performing mortgage loans denominated in home or foreign currency we followed some basic principles:

- *The policy goal is to reduce overall systemic risk:* The main objective is not to redistribute realized profits and losses in the name of social justice (this is rather a political question), but to reduce the country's exposure to future shocks in order to diminish macro-level financial vulnerability.
- *There is a need for state intervention:* Systemic risk can be viewed as a negative externality. Contracting parties (lender and borrower) benefited from the transaction while they contribute to the instability of the financial system. As a consequence, the cost of the increased systemic risk is paid by other, non-contracting players (e.g. taxpayers). Due to the large number of stakeholders and the high transaction costs it cannot be expected that the problem of negative externalities will be solved privately. Thus, in defense of the community's interests, state intervention is justified.
- *Legal contracts should be respected:* Debtors must be regarded as responsible actors, therefore they have to repay their debt and have to bear the all corresponding risks provided that they were properly informed before signing the contract. On the other hand, any compulsory retroactive modification of existing contracts between lenders and borrowers should be avoided as it is contrary to the rule of law. A new scheme can be applied if and only if contracting parties agree on that.

Ability-to-pay depends most of all on the repayment burden, which can be measured as the ratio of the repayment to the net income (PTI, payment-to-income ratio), see Banai et al (2014). In case of FX mortgages PTI depends on three risk factors: 1) the net income, 2) the exchange rate and 3) the interest rate of the loan. The basic idea of our proposal is to reduce the sensitivity of the non-performing portfolio to all of these factors:

- *income risk to be hedged via income contingent (IC) repayment;*
- *foreign exchange risk to be dissolved by forint conversion of the non-performing loans;*
- *interest rate risk to be diminished by fixing the margins at lower levels.*

⁵ A more detailed discussion of the proposal can be found in Berlinger, Walter (2013) and Berlinger, Walter (2014) in Hungarian.

The detailed discussion of the effects of forint conversion and the interest rate mechanism can be found in Berlinger-Walter (2013) and Berlinger-Walter (2014).

Contrary to fix repayments, income contingent repayments are automatically and continuously adjusted to the actual income of the borrower over the whole maturity of the loan. In these systems repayment is a monotone increasing function of the income. In a pure income contingent scheme repayments are calculated as a fix percentage of the actual incomes. The maturity of the loan is not predetermined; it depends on the income path of the given borrower and the interest rate over the time. The more someone earns, the quicker she is able to repay her debt. Other distinctive feature of income contingent loans is the (more or less) direct involvement of the tax authority in the collection mechanism. For the extensive discussion of the role of income contingent schemes in student lending see Barr (2012). A less flexible type of income contingent repayment mechanism was proposed by Modigliani (1976) specifically in relation with the mortgages.

Until recently, income contingent loans were applied only in state managed student loan schemes, at least at mass level. However, Stiglitz et al. (2014) proposes to expand its scope to other retail lending situations for example in case of unemployment, maternity leave and research sabbatical or any kinds of temporary financing problems. Stiglitz (2013) proves within the framework of an optimization model that income contingent loans (IC loans) are an effective tool of income smoothing over the lifetime; and its application increases the welfare, especially in case of high uncertainty, asymmetric information or other market failures.

In relation with the repayment cash-flows, IC schemes have two important characteristics, such as:

- (i) *Patience*: the maturity and more importantly the average duration of the loan repayments increase significantly.
- (ii) *Flexibility*: as the repayment automatically adjusts to the income, temporary low income does not lead to default. On the other hand, high income periods speed up the repayment; hence effectively reduce the lender's exposure.

Income contingent loans are similar to equity financing, when the provider of the financing receives a part of the profit (here future incomes). In this setting, outside financing does not increase the leverage of the borrower; hence default risk is practically eliminated. However, income contingent repayments are not a panacea to all kinds of financing problems. When we switch from fix to IC, we minimize default risk but at the same time we increase the cash-flow risk of the lender and we increase the moral hazard, because borrowers will be tempted to do less efforts or to hide their incomes, see Tirole (2006). It is extensively proved theoretically in the field of corporate finance that debt-like financing (fixed repayment) is the optimal choice from incentive perspective, because it motivates the

lender (the agent) to do her best in order to maximize the value of the underlying investment. This is a robust result, as it is true 1) for limited liabilities and risk neutral borrowers, Innes (1990); 2) for unlimited liabilities and risk averse borrowers, Hermalin and Katz (1991) and also 3) for limited liabilities and risk averse borrowers, Dewatriport (2003). Intuitively, the incentive-optimality of the fixed repayment scheme is due to the fact that all the excess return over the fix repayment will remain in the borrower's pocket; that is why she becomes highly motivated to succeed. It is also important to emphasize that when running an IC scheme, the efficiency of the tax mechanism (administration costs, enforcement power etc.) is also a key factor.

Based on the above considerations, we can conclude that an IC scheme can be favorable to a fix one if:

- default risk is a more important concern than moral hazard (e.g. in crisis time, or in case of long term and unsecured loans like student loans, or when moral hazard can be effectively eliminated in other ways);
- cash-flow risk can be reduced or managed (e.g. it is diversifiable within a big portfolio or the lender has easy access to liquid capital markets);
- the tax system is well developed or there is a strong commitment to improve it;

In our opinion, in relation with the non-performing mortgage loans in Hungary default risk is definitely dominating moral hazard. The size of the loan portfolio is so significant that in case of some external (or internal) shocks individual defaults can easily reach a critical level which is not manageable anymore, which can lead to a widespread economic and social breakdown. Moreover, if lots of mortgages were executed at the same time, the real estate prices would drop significantly, hence collateral values would melt down. In this situation, especially when there is a massive oversupply on the labor market, fears that people were reluctant to work harder seem less relevant. Similarly, cash-flow risk is much easier to manage than default risk and systemic risk. And finally, the Hungarian tax system is developed enough to support the Hungarian income contingent student loan scheme since 2001, therefore the institutional capacity is also available⁶.

Notwithstanding, even if these requirements hold, when designing an IC scheme, incentives to repay must be in the focus. In our proposal the elements of the incentive system are the followings:

- *Mortgages are maintained until full repayment*: borrowers can live in their own home while they are fulfilling their obligations on time according to the IC repayment scheme. If a borrower were in a delay of more than 90 days, her propriety would be

⁶ The administration costs per year are under 1% of the portfolio value, see <http://www.diakhitel.hu/index.php/en>.

sold out and she would lose it irrevocably. At the same time borrowers will have the opportunity to keep their housing even if they earn a little for a long time.

- *Repayments have a lower limit*: borrowers are required to repay at least a given percentage (repayment rate) of the actual minimal wage. Experience with the Hungarian student loan system also underpins that minimal repayment requirements help to keep contact with the borrowers and make them more disciplined.
- *Disciplined debtors have lower interest rate*: borrowers repaying regularly benefit from lower interest rate in line with their lower risk (system of risk adjusted interest rate margins). This is an important tool to attract borrowers to enter the new, income contingent scheme and to keep them disciplined at the same time.
- *Borrowers possess an attractive early repay option*: in case borrowers have some out of ordinary funding (legacy, prize, project etc.) they can choose to repay her debt even in a lump sum at face value without any extra fee. In this way they can get rid of the accumulating interest rates. In the Hungarian student loan scheme the early repayments are higher than regular repayments⁷, therefore this provision is remarkably effective in motivating quick repayment.

We can summarize that incentive problems in an IC scheme can be effectively tackled in case of mortgage loans, not least because mortgages create strong incentives to repay by their nature. In the following part we show that the proposed strategy creates significant value added both for the borrowers and the lenders.

3. MODELLING AND SIMULATIONS

In this analysis we only focus on the non-performing loans, i.e. those debtors who are currently not able to pay back their obligations. In accordance with our proposal, these loans are converted into forint, and are repaid in an income contingent way.

With the help of a micro-simulation model we compared the operation of the income contingent scheme to the fixed one by assuming that non-performing loans are terminated, collaterals are sold and credit losses are written off as it follows from the usual banking practice.

3.1. GENERAL TERMS, NOTATIONS AND ASSUMPTIONS

The micro-simulation model was calibrated to the real world data but in order to focus on the main relationships we made some simplifications. For example cash flows are modelled on

⁷ <http://www.diakhitel.hu/index.php/en>

an annual basis and growth factors (income growth rate, interest rate of the loan, inflation, refinancing cost, risk margins, etc.) are supposed to be constant.

In the new *income contingent scheme* the repayments are due both in the active and the retirement periods. The net nominal income (J) of a given debtor increases from now ($t=0$) until retirement ($t=N$) according to the growth rate, which is composed of the real income growth rate (w), and the inflation (i). At retirement a reduction in incomes is supposed in line with the replacement rate (h – first pension income / last net wage income). Then the pension grows by the same rate as the wage income before, until the death of the borrower ($t=L$).

$$J_t = J_{t-1}(1+w)(1+i) \text{ ha } t \neq N \quad (1)$$

$$J_N = hJ_{t-1}$$

Loan repayment (T_t) is purely income contingent, hence it equals α percentage of the actual income (net income or pension), until the debt (H_t) is paid back or until the death of the borrower at the latest.

$$T_t = \min(\alpha J_t; H_t(1+y)) \text{ ha } t \leq L \quad (2)$$

$$T_t = 0 \text{ ha } t \geq L$$

The debt of a borrower in the end of year t (H_t) is increased by the accumulating interest rate (y) and is decreased by the repayments (T_t), but it cannot become negative:

$$H_t = \max(H_{t-1}(1+y) - T_t; 0) \quad (3)$$

The interest rate of the loan (y) is the sum of the base rate (BUBOR) and a fixed risk margin (c).

$$y = BUBOR + c \quad (4)$$

The year when the total debt becomes 0 (full repayment is reached) is denoted as t^* . But the maturity of the loan (M) cannot be longer than the lifetime of the debtor (L).

$$M = \min(t^*; L) \quad (5)$$

We also supposed that the nominal value of the collateral (F_t) is increasing by the inflation (i) and is decreasing by the depreciation rate (a).

$$F_t = F_{t-1}(1+i)(1-a) \quad (6)$$

In case of the borrower's decease ($t=L$), the collateral is executed, i.e. the real estate is sold, and the outstanding debt is reduced by the sale revenue. When calculating the sale revenue we supposed that the bank cannot sell the collateral at its nominal value but at a reduced price decreased by a d liquidation discount. If the balance (=revenue-debt) is positive, it is inheritable otherwise the remaining debt is written off and the deficit is considered as the loss of the bank.

As we can see, banks have two types of incomes: repayments from the debtors and eventually the sale of the collaterals. If all of these incomes are calculated in present values and are compared to the currently outstanding loan we receive the so called profit (also in present value) (Π).

$$\Pi = \text{PV}(\text{repayments}) + \text{PV}(\text{collateral}) - \text{outstanding loan}$$

$$\Pi = \sum_{t=1}^M \frac{T_t}{(1+f)^t} + \frac{\min(H_M; F_M(1-d))}{(1+f)^M} - H_0 = T_0 + F_0 - H_0 \quad (7)$$

We have to notice, that in the practice this excess income over the refinancing costs is not a pure profit, as this must cover all the administrative expenses and also the credit risk.

Cash flows are discounted at the banks' refinancing cost (f), which is the sum of the base rate ($BUBOR$) and a fixed margin reflecting the credit risk of the bank (b). In case the government provides a preferential refinancing at rate (p) to support the program, the refinancing cost can be even lower.

$$f = \min(BUBOR + b; p) \quad (8)$$

However, if the bank refused to participate in the income contingent scheme and sticks to the original, *fixed repayment schedule*, then non-performing loans would be managed in the usual way: positions are closed, collaterals are sold out and the remaining debts are written off. In this case the profit (Π') is defined in the following way:

$$\Pi' = F_0(1-d) - H_0 \quad (9)$$

The difference between the two values ($\Pi - \Pi'$) is due to the extra effort the bank takes in order to get repaid by entering into the income contingent scheme instead of closing its positions right now. This is why we call this difference as the value added of the income contingent scheme (VA).

$$VA = \Pi - \Pi' \quad (10)$$

Having simulated the cash flows of the bank, the ex post return can also be determined by calculating the rate at which the present value of future cash flows is just equal to the current value of the outstanding loan (IRR, internal rate of return). If all debtors were able to fully repay their debts, collaterals would not be executed at all and ex-post return would equal the interest rate of the loan (y). Otherwise, the internal rate of return is less than the interest rate of the loan.

3.2. INDIVIDUAL SCENARIOS

The input parameters of the model can be grouped into three categories:

- *Debtors' attributes*: age, debt, LTV and income
- *External macro-economic conditions*: depreciation of the collateral (real estate), inflation, liquidation discount of the collateral, BUBOR, growth rate of incomes, retirement age, replacement ratio of pensions and refinancing cost of the bank
- *Decision / control variables*: repayment rate and risk margin for the non-performing loans

Parameters of the first two categories are exogenous, hence cannot be influenced by the stakeholders (debtors, banks, state) while decision variables can be discussed during the design and implementation of the system and the final calibration should be the result of a consensus adopted by all the parties. Table 2 presents the parameter values we applied along the calculations. We also indicated how the given representative value was determined. The actual USD/HUF rate is 246.

Depending on the income of the borrowers and the number of co-borrowers within the contract we defined four different scenarios:

- A: One borrower earning a minimum wage
- B: Two borrowers earning minimum wages
- C: One borrower earning an average income
- D: Two borrowers earning average incomes

Table 2

Parameter values

	Parameter value	Remark
DEBTORS' ATTRIBUTES		
Expected lifetime of debtors (L)	30 years	average ⁸
Debt outstanding (H_o)	USD 33 000	pessimistic estimation ⁹
Loan to value ratio ($LTV = H_o/F_o$)	100%	pessimistic estimation
Monthly net average income (J_o)	USD 623	average ¹⁰
Monthly net minimum wage (J_o)	USD 270	actual regulation ¹¹
EXTERNAL CONDITIONS		
Depreciation of real estates (a)	2%	accounting standard
Inflation (i)	3%	realistic estimation
Liquidation discount of the collateral (d)	0,4	realistic estimation
BUBOR (12 months)	3.5%	actual value
Annual growth rate of incomes (w)	3.5%	realistic estimation
Retirement age	age of 65	actual regulation
Replacement ratio of pension (h)	0.8	realistic estimation
CONTROL VARIABLES		
Repayment rate relative to the net income	30%	assumption
Risk margin of non-performing loans (c)	4%	assumption
Refinancing cost of the bank (f)	BUBOR+0.5%	assumption

Source: the authors

When examining the effects of introducing an income contingent repayment scheme output variables for each scenario were calculated.

Output variables from the borrowers' perspective:

- monthly net (disposable) income (J_o)
- PTI ratio (relative to the net income) in the fixed scheme (PTI_{fixed})
- PTI ratio (relative to the net income) in the income contingent scheme (PTI_{ic})

Output variables from the lender's perspective:

- maturity of the loans (M)
- total amount of collaterals sold relative to total bank income ($F_o/(F_o+T_o)$)
- profit of the lender under income contingent repayment (II)
- value added ($II-II'$)
- ex post annual return (IRR).

⁸ The age of an average debtor is currently 44 years based on the portfolio of one of the major mortgage/retail banks. At this age the expected additional average lifetime for women is 34, for men is 26 years. Thus the average remaining lifetime of men and women is around 30 years.

⁹ The average debt is around USD 28 000 (total portfolio/number of contracts=3,4 billion/120000). To be prudent, we calculated with a higher-than-average debt (around the 80% quantile).

¹⁰ The average gross income in Hungary in 2014 January-September was HUF 234 000, hence the monthly net average income was HUF 153 270 (without family tax alleviations).

¹¹ The monthly net minimum wage in Hungary in 2014 is HUF 66 480 (without family tax alleviations).

Table 3 presents the output variables resulted from the model calculations based on the parameter values in Table 2.

Table 3

Output variables for different scenarios

Scenarios	A one wage min.	B two wages min.	C one income avg.	D two incomes avg.
BORROWER				
Monthly net income in USD (J_o)	270	541	623	1246
PTI fixed	116%	58%	50%	25%
PTI income contingent	30%	30%	30%	30%
LENDER				
Loan maturity in years (M)	-	30	22	9
Collateral/ total income $F/(F+T)$	23.79%	0%	0%	0%
Profit in USD (II)	978	17 820	13 657	5 554
Value added in USD ($II - II'$)	14 178	31 020	26 857	18 754
Ex post annual return (IRR)	4,17%	7,5%	7,5%	7,5%

Source: the authors

We can see from Table 3 that PTI ratios in the fixed scheme ranges widely between 116% (scenario A) and 25% (scenario D), hence it is not surprising that in the lower income categories NPL ratio are so high at the present time. The major advantage of the income contingent scheme is that PTI is automatically fixed and is constant across all income categories and over the whole maturity of the loan (20% to the gross income, thus 30% to the net income). In this way, by the introduction of the IC scheme, the repayment burden is significantly alleviated in scenarios A, B and C. This is partly due to the longer maturities, but more importantly to the expected income growth which enables future repayments to increase as well.

Results show, that except for scenario A debtors are able to fully repay their obligations during their expected lifetime. Even in the most unfavorable case (scenario A) borrowers repay the capital and the refinancing costs, and it is only the risk margin (4%) which is not fully refunded. The repayment is financed partly from the sale of the collateral (at the end of the life of the borrower), which accounts only for the 23,79% of the total income of the bank. However, if the bank decided to promptly terminate the overdue contract and to sell the collateral immediately, then its revenue would be much less which is reflected in the highly positive value added of the income contingent scheme ($VA = \text{USD } 18 \text{ thousand}$ which is more than the half of the actual debt, $H_o = \text{USD } 33 \text{ thousand}$).

We can also observe that as the income of the debtor(s) grows the expected maturity of the income contingent loan decreases sharply. While in some cases the maturity can be very long (30 years or more) depending on the loan portfolio's composition the average maturity under the IC scheme can be fairly close to the actual maturity of the fixed loans (15 years). Collaterals are executed only in scenario A; in the other cases debts are repaid solely from the future incomes. It is interesting to note, that the profit of the lender is not a monotone function of the income, because as income grows, the maturity of the loan decreases, hence the borrower pays less risk margin in total. Two borrowers on minimal wages (scenario B) are able to fully repay their debt, but only in 30 years, therefore they pay a lot of risk premium; and this is why they become the most profitable clients. Not surprisingly, the value added is closely related to the profit of the lender, thus it shows a similar pattern. The ex post return equals to the interest rate of the loan (7.5%) in scenarios B, C and D, where debtors fully repay. However, in scenario A the ex post return is somewhat lower, because the debtor will not be able to repay all its obligations and a part of it will be written off as the loss of the lender.

Of course, in special cases the bank might get into worse scenarios than presented above, for example in case of higher LTV, early death of the debtor, lower incomes, or due to external parameters changing adversely relative to our assumptions. From this aspect, the most powerful macro-economic factors are the growth rate of real incomes and the real interest rates; more precisely, it is their long term relation which matters the most. In our model we prudently assumed a real income growth rate of 0.5% being lower than the real interest rate ($4\% - 3\% = 1\%$).

3.3. PORTFOLIO EFFECTS

In order to analyze the portfolio level effects of the introduction of the income contingent scheme, we simulated the total non-performing mortgage portfolio presently denominated in foreign currency described in the reports of the National Bank of Hungary (MNB 2013) and (MNB 2014). This portfolio includes about 120 000 contract with a total volume of about USD 3.4 billion. The estimated inner structure of the portfolio is presented in Table 4.

Unfortunately, in the other dimensions, detailed statistics were not available. Hence when building up the micro-simulation model, parameters were adjusted to the available aggregated statistics as closely as possible. If no data were available, then we made realistic assumptions.

Table 4

**The estimated structure of the non-performing FX mortgage portfolio
(2013, in USD)¹²**

Debt	Frequency	Number of contracts	Portfolio size
6 000	14%	16 800	100 800 000
16 000	32%	38 400	614 400 000
26 000	24%	28 800	748 800 000
36 000	12%	14 400	518 400 000
50 000	11%	13 200	660 000 000
70 000	4%	4 800	336 000 000
100 000	2%	2 400	240 000 000
140 000	1%	1 200	168 000 000
	100%	120 000	3 386 400 000

Source:

http://www.mnb.hu/Root/Dokumentumtar/MNB/Kiadvanyok/mnbhu_stabil/mnbhu_sta_b_jel_201111/Szakertoi_prezentacio_HUN_Stabililitasijelentes_201111.pdf, pp. 15

We created a population of borrowers by simulating their main attributes: age, debt, LTV and income; while external macro-economic conditions and control variables presented in Table 2 remained unchanged. We also assumed that the four attributes were independent from each other. Simulation was run in an Excel VBA program for 10 000 loan contracts, and this population was then multiplied by 12.

Age: We assumed that the age of the debtors follows a normal distribution with a mean of 44 years and a standard deviation of 6 years. We also introduced a lower bound for the age at 25 years. For the sake of simplicity we assumed that debtors within the same contract were completely identical. We supposed that all borrowers work until the age of 65, and then live 9 years as pensioner.¹³ Early death was not modelled, because this type of risk is hedged via life insurance contracts corresponding to the loan contract.

Debt (H_0): Debt size was estimated according to Table 4.

Loan to value ratio (LTV): We assumed that the distribution of the LTV ratios is normal too with a mean of 1.2 and a standard deviation of 0.2. As LTV cannot be negative, we introduced a lower bound of 0.

Monthly net incomes (J_0): Although there are publicly available reports on the distribution of the incomes of the whole Hungarian population, these statistics cannot be used here because the income of this special group (non-performing borrowers) might be totally

¹² We supposed that in the case of the non-performing loans the weights of the categories are the same as in the case of the whole FX mortgage portfolio.

¹³ This is consistent with Table 2, remark 7.

different, certainly, lower income categories are over-represented. So, as no reliable statistics on the income of non-performing borrowers were found, we assumed that only four income scenarios (A-B-C-D) existed, exactly those ones we defined in the previous point. Frequencies were estimated according to some experts' opinion, see Table 5.

Table 5

Estimated frequency of the income scenarios

Scenarios	A one min. wage	B two min. wages	C one avg. income	D two avg. incomes
Monthly net income in USD (J_o)	270	541	623	1246
Frequency ¹⁴	30%	40%	20%	10%

Source: aggregating experts' subjective opinion

Income paths were simulated by supposing that the annual real wage growth rates were independent and normally distributed stochastic variables with a mean of 0.5% and a standard deviation of 0.2%.

Having created an artificial but realistic population we calculated the performance measures from the lender's point of view defined in Table 3. In this parameter-setting 67.43% of the borrowers were able to fully repay in their lifetime and there was no need for selling out the collateral. Moreover, those individuals who could not fully repay their obligations proved to be profitable for the bank in 87% of the cases, because collaterals were enough to compensate the capital and its accumulated financing cost and even a part of the risk premium. If we take a helicopter view of the whole portfolio, it turns out that that the aggregate profit (Π) is around USD 0.45 billion which is more than 13% of the portfolio's actual face value.

However, if, contrary to our proposal, the banking sector decides not to participate in this program, and defaulted debt contracts are terminated immediately by executing the mortgages at a liquidation discount of 40%, then according to our calculations about 48% of the portfolio face value would be immediately lost (USD 1.64 billion)¹⁵. Thus, if our assumptions hold, the value added resulting from the fix-to-IC switch is $0.45 + (-1.64) = -2.1$ billion in USD. It is important to emphasize that the introduction of the IC scheme does not increase the credit risk of the banks, as all the risks are already present in the system.

Of course, this impressive performance is also due to the cheap state refinancing. It is worth calculating the costs of this support affecting the state budget. If the banks' refinancing

¹⁴ Four practitioners were asked and their answers were averaged.

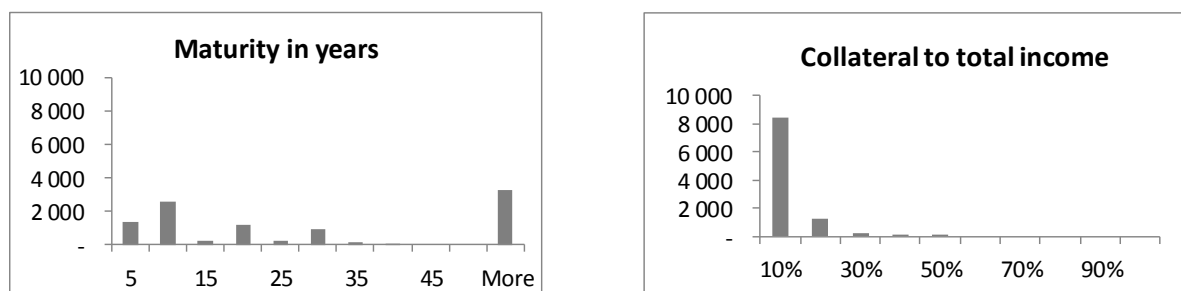
¹⁵ The price impact of the increased selling activity was not taken into consideration.

costs are around $BUBOR+2\%=3.5\%+2\%=5.5\%$, then the state refinancing at 4% induces an annual public cost of 1.5% based on the portfolio's face value. Therefore, in the first years the total public costs would be around USD 0.05 billion, but later on as debts are gradually paid back it will significantly decrease. However, these costs are not effective while banks are able to pay back the refinancing loans (no default event occurs) because the interest rate of the refinancing loans (4%) exceeds Treasury bond rates (3.5%). In our opinion some state support in form of cheap refinancing can be justified, especially if we also consider the spillover effects.

Finally, in order to get insight into the inner structure of the portfolio performance it is worth examining the distribution of the output variables too, see Figure 3, 4 and 5.

Figure 3

Maturities and the weight of the collateral



Source: micro-simulation

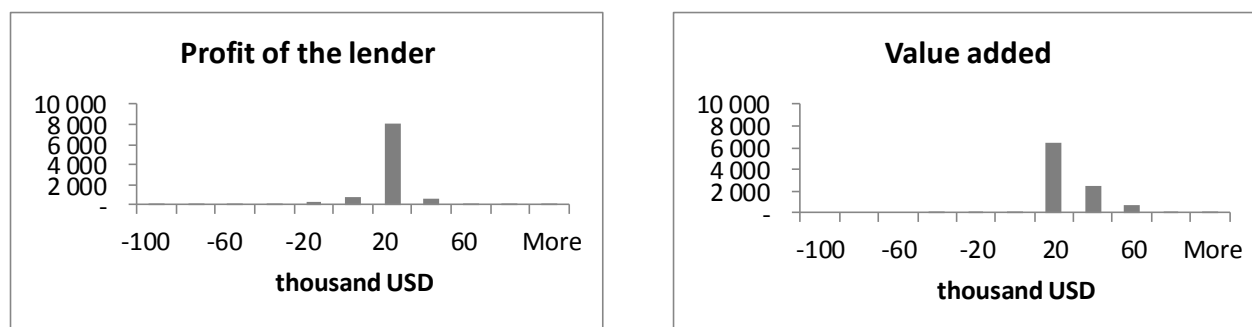
It can be seen on Figure 3 that loans are repaid within 35 years except for those that cannot be repaid at all. Moreover, 38% of the loans are repaid within 10 years; hence the average maturity of the repaid loans is fairly short being around 15 years, exactly like in the fixed scheme. In case the borrowers take advantage of their early repayment option, maturities can be even shorter.¹⁶ Another advantage of the IC scheme is that the sales of the collaterals are postponed and dispersed in time; therefore adverse price impacts on the real estate market are minimized. The weight of collateral revenues is remarkably low within the total income of the bank; cash-flows are dominated by the income contingent repayments.

Figure 4 presents the distribution of the lender's profit and the added value of the IC scheme relative to the fixed one.

¹⁶ We did not model early repayment behavior of the debtors.

Figure 4

Profits and the value added of the IC scheme

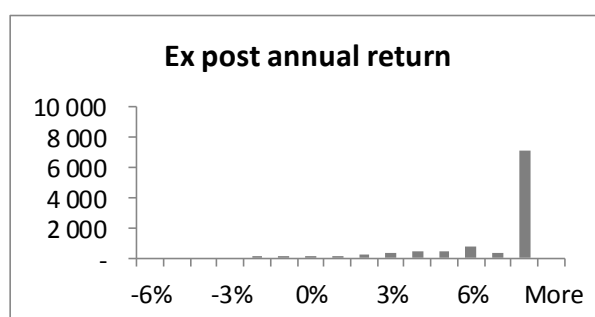


Source: micro-simulation

In more than 80% of the cases the lender's profit on one contract is between 0 and 20 thousands (the average face value is 28 thousands). The value added is calculated as the difference between profits in the IC and the fixed schemes. Given that profits in the fixed scheme are negative (due to the forced sale of the collaterals), value added of the IC scheme is even higher than the profit. Both part of Figure 4 and also Figure 5 underpin that banks can improve their positions significantly by entering the IC scheme.

Figure 5

Ex post annual returns



Source: micro-simulation

As we could also see in Table 3, when debtors fully repay on finite time horizon the ex post annual return of the lender equals the interest rate of the loan (7.5% in our model). Of course, there are some cases when the ex post annual return is negative, but this risk is practically negligible.

4. CONCLUSIONS

We argued that if certain conditions hold IC repayments may be favorable to fixed ones not only in student lending but also in the case of non-performing mortgage loans. On this ground, we proposed to convert the Hungarian non-performing household mortgages denominated in foreign currencies into forints, to lower the interest rate margins and to introduce income contingent repayments for the remaining debts. This would be a voluntary scheme where contractors (banks and borrowers) can switch to only if both of them agree on.

We have also shown in the framework of a micro-simulation model that with the help of an IC scheme the vast majority of non-performing loans can be repaid while borrowers are not overburdened. The proposed scheme is attractive for all the stake-holders.

It is attractive for the *borrowers*, because PTI ratios in the lower income categories could drop to one third or even to one fourth as Table 3 shows. Default risk is practically eliminated while low earning borrowers can keep their home over their lifetime, and it also remains inheritable to their children.

It is attractive for the *lenders*, because low PTI ratios and strong incentives to repay (mortgage right, minimum repayment requirement, lower interest rates for good borrowers and early repayment option) lead to low NPL ratios, which creates high value added for the banks (2.1 billion of USD for a portfolio of 3.4 billion of USD). Cash-flow risk can be managed by portfolio diversification and/or by refinancing on the capital markets or by the state. The price impact on the FX market and on the real estate market is also minimized as HUF conversions and sales of the collaterals are postponed and dispersed over time. Finally, it is also clear that in this mass volume income contingent repayment is much cheaper than endless bilateral negotiations between bank and client.

It is also attractive for the *state*, because systemic risk is effectively reduced at a fairly low public cost. State support to the scheme consists of the operation of the collection mechanism by developing the tax system, the cheap refinancing for the banks and assisting HUF conversions in order to attenuate the price impact on the FX markets. In this way, state can exploit synergies between banking system, tax system, student lending etc., and can attenuate negative externalities without intervening into private contracts by force. The technical problems of practical implementation can also be resolved based on the international and Hungarian experience with student lending.

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